and unexpected type of vertebra, a pelvis with all the bones co-ossified as in existing birds, and a set of osseous dermal plates extending from the base of the skull along the neck over the vertebræ.

GEOLOGICAL SURVEY OF NEW ZEALAND.—Dr. Hector's Report for 1882 has just been received. It contains some additions to our knowledge of the geological structure of the country, but these do not involve any marked alterations in the system of classification already adopted for the formations, but rather tend to establish its general applicability. The Report is specially characterised by the attention paid to the development of the mineral resources of the colony. Mr. S. H. Cox, in compliance with specific instructions, made a careful examination of the gold-fields of the Cape Colville Peninsula and of other mineral tracts, while Mr. A. McKay reported on some antimony and other lodes. The geology, petrography, and palæontology of the islands have likewise received attention. The schists of the Reefton district are regarded as a metamorphic series of Silurian age, as they can be traced into fossiliferous Silurian strata. The granite-porphyries by which they are traversed were intruded into them subsequent to the Devonian rocks. The metamorphic series is covered in some places by the Devonian beds, from which fossils have been obtained at a number of new localities. The auriferous rocks of Reefton are referred to the Matai or Carboniferous formation, and are believed to lie unconformably on the younger Devonian rocks. The Cretaceous and Cretaceo-Tertiary series form a continuous sequence in which coal has long been known to occur. Seams of coal, four to ten feet thick on an average, characterise certain horizons, one seam at the head of the Murray Creek reaching even to thirty or forty feet. The coarse sandstones and grits among which the coals lie are represented as being conformably overlaid by Miocene gravels.

THE AUSTRIAN GEOLOGICAL INSTITUTE.—This admirable organisation, under the energetic management of its Director, F. Ritter von Hauer, shows no sign of any diminution in its activity or of any lessening of the wide scope of its labours. Among the recent numbers of its *Verhandlungen* some interesting papers have appeared, of which may be mentioned: A. Bittner, on the Limestone Alps of Salzburg; E. Tietze, on the occurrence of turquois in Persia; V. Hilber, on the geology of the region between Krzyzanowice and Tarnobrzeg; D. Stur, on some fossil plants from South Wales; A. Böhm, on geo-isothermal lines under mountains. The last two numbers of the *Jahrbuch* are full of important memoirs. Among these reference may be made to Bittner's Report on the survey of the Triassic region of Recoaro; Paul's "Recent Additions to our Knowledge of the Carpathian Sandstone"; Dr. Tietze's essay on the geology of Montenegro, and the continuation of his contributions to the geology of Gallicia.

ON NORTHERN NORWAY UNDER THE GLACIAL AGE

THE *Stream of Inland Ice.*—From the broad sound between the Kval Island and the province of Finmarken, from which the Troms Island juts forth, the Kval Sound—about 20 km. in length—leads to the open ocean. Outside the Kval Sound several little islands rise from the sea, while beyond the coast is girded by holms and rocks termed the "Skjærgaard." A little south of the Troms Island the Balsfjord, about 60 km. in length, cuts into the land, closed at the bottom by small ridges leading up to the valley in which the Maals River flows, and to the borderland between Norway and Sweden, chiefly through the long Divi Valley. The borderland embraces large mountainous tracts, where peaks rise to an elevation of 1569 m., crossed by dales and high valleys.

In the district described, the local conditions during the Glacial age seem to have been remarkably suited to the formation of large masses of ice. These would have their natural outlet towards the Maals River, through the Divi Valley, and the main stream has no doubt therefrom flown down the Maals Valley, but an arm may have curved more to the north along the northern slope of the Mauken ridge, and by ice-streams from this and from the gigantic high plateaux around the Maar peaks down to the bottom of the Balsfjord. From here the joint stream would have moved further forward to the sounds along both sides of the Troms Island, and thence, through the Kval Sound, over the islands in the Skjærgaard. The channel described has a length of 215 km.

As is generally known, the inland ice of Scandinavia is assumed to have shot far beyond the edges of the peninsula. Thus from Southern Norway the inland ice is believed to have moved forward along the fjords, and filled the entire North Sea as far as England, while further north it has been curved in a more northerly direction, by the ice-streams issuing from Scotland, towards the Orkneys and the Shetlands. It might be supposed that similar conditions existed during the Glacial period in the north of Norway; but from what is known at present there is nothing indicating that the Glacial age has appeared in a more severe form in the southern than in the northern part of Norway; it seems, in fact, from the geographical situation of the land, that the reverse must have been the case. There are besides, as I will presently show, indications which seem to demonstrate that the ice-masses of the Glacial age, at all events in certain parts of Northern Norway, have attained an extent which equals those of Southern Norway, as, for instance, those along the Sognefjord, 1700 m. to 1800 m. in depth. On the high plateau behind the Divi Valley, close to the frontier, the cone of the Great Jerta, built of amphibolitic slate, rises to a height of 1569 m. Nowhere have granite strata been found intercepting this slate. On the top of this peak a large travelled granite block was found, which in most probability has been transported thither from the extensive granite field which stretches forward on both sides of the frontier. The ice which has moved down the Divi Valley must therefore have been very nearly 1600 m. in depth.

There seems every reason to suppose that the channel from the bottom of the Balsfjord to the Skjærgaard has, during the Glacial age, boasted a comparatively uniform depth; and, supposing the sea to have been about 188 m. higher than at present, this channel would nowhere have been deeper than 470 m. An ice-stream moving forward by this channel, and which probably had a thickness of 1600 m., must have moved forward along its bottom, and most probably with a quick motion. If the ice-streams from the south-west of Norway have, as assumed, moved forward, and filled not only the fjords to the bottom, but the entire North Sea to England, we may conclude that this should also have been the case in the channel in question during the Glacial period. If this has been so, marked traces of such an ice-stream would, no doubt, have been visible from the very bottom of the Balsfjord right out to the Skjærgaard; but the researches made here point in a different direction. I will elucidate this by following the channel referred to *from* the ocean coastwards.

About 11 km. from the mouth of the Kval Sound, in the open ocean, lies the little Ris Island, surrounded on south, west, and north by a great number of tiny islands, reaching a height of 100 m. It is formed of a ridge running north to south, in the west sinking abruptly into the sea, but which in the east sinks into a low-lying plain, from which several isolated knolls spring forth. Several of these knolls are connected with the main island by sand dunes, and have most probably at no distant time formed separate holms. Most of the numerous holms surrounding the Ris Island are small, and only rise a few feet above the water. The mineral of which this group of islands is formed is a hard kind of gneiss, greatly interspersed with granite more or less pure; the mineral is, in fact, with its petrographical variations and forms, rather to be considered a kind of granite-gneiss, a name which is given to it in these parts. The strike of the granite strata is, roughly speaking, north to south, with a sudden dip to the east. By its structural condition this mineral should be greatly affected by smoothing and polishing agencies, and also retain the traces of such. Should, therefore, the inland ice at a certain period have moved forward along the Kval Sound, the group of islands around the Ris Island would undoubtedly bear the most patent indications of this action. The polishing phenomena are often met with at lower levels, which either lie within the littoral belt, at high tide under the sea, or rise only a few feet above high tide, but with the sea continually washing over them. At higher elevations these phenomena are rarely discovered. Here severe destructive forces have been at work on the previously polished surfaces, and the numerous sea-birds breeding on these islands have further contributed to the corrosion.

Several circumstances seem, however, to indicate that the polishing in question cannot be referred to the scourings of the ice in the Glacial period, but is of a far later date. The rapid destruction seems in fact to demonstrate that the smoothing must be referred to agencies of shorter duration. The smooth, ings which are shown—certainly not very marked—seem to point in this direction, while the smoothing along the lower levels of the holms referred to above are generally met with more in the parts most exposed to the fury of the sea than inland. The smoothing appears but rarely in spots on the lee side of the ocean, even where they might be assumed to have been very exposed to the glaciers. I have therefore come to the conclusion that the smoothing phenomena observed here must be ascribed to the erosion of the sea, which, under its action in the littoral belt, carries with it finer as well as coarser materials of scouring. Striæ have nowhere been observed on the Ris Island or the surrounding islands.

If ice-streams from the southern part of the Scandinavian peninsula have carried blocks from the mountain plateaux of Sweden and Norway across the Central European plain to England, to the Orkneys, and the Shetlands, an ice-stream moving along the Balsfjord and further along the channel described above through the Kval Sound should naturally have progressed in the same manner, and strewn blocks along its whole course. This is, however, not the case. On the Ris Island, thus, and surrounding islands, not a single boulder or travelled block whose place of birth could have been on the upland behind has been found. The mountains along the Balsfjord and towards the Troms Island is mostly built of slaty minerals, such as glimmer-slate (interspersed with crystalline chalk), quartz, sandstone-like slate, &c. Such minerals might have been greatly subjected to being ground away during a longer transport, and that travelled blocks of this kind are not found might be ascribed to this circumstance; but among the travelled blocks strewn over the Central European high plateau there are found also many of slate, which are supposed to have been transported thither from Scandinavia, and if these have been able to resist the destructive agencies during such a long transport, they would decidedly have done so here where the distance is so short.

Among the softer minerals forming the mountains from the Balsfjord there frequently occur strata of harder nature, as, for instance, of gneiss, massive amphibolites, and eclogites, while Saussurite appears in the bottom of the fjord. There are minerals whose composition would enable them to resist the severest destructive agencies even during the longest journey. The total absence of foreign travelled blocks on Ris Island and adjacent holms is therefore hardly to be reconciled with the supposition that continuous streams of ice from the inland moved thither. Neither is moraine drift met with about the archipelago in question.

Just north of the Ris Island, the Sandviks Island, 407 m. in height, rises above the sea. Along the whole eastern side extensive accumulations of sand containing marine shells are met with to a height of 63 m. In the higher-lying layer the sand is, however, poor in such remains, although fragments may be found at an elevation of 56 m. Here it seems as if the coast districts must have been earlier denuded of the local glaciers of the post-Glacial period than the upland behind. Along the Troms Island and the adjacent district the shell-bearing layer of sand is never found above 13 m., while in the clay deposits along the rivers fossil shells are never found at a higher elevation than 38 m. The Troms Island has, however, at a time when the sea in relation to the rock was 40 m. higher than at present, been greatly covered by local glaciers, while the coast district beyond must have been almost free from such. The conditions for the development of a more copious fauna of mollusks have thus existed along the outer coast *earlier* than in the fjords behind. It appears therefore that during the transition from the Glacial to the post-Glacial period the milder climate has spread from the sea *coastwards*, although, as it seems, very slowly.

We now turn to the district behind the channel referred to, particularly to the little Troms Island, where there has been special opportunity of examining these indications. The island is 11 km. long and 157 m. in height, and, lying just in the flow of the ice-stream, was situated so that the travelling glaciers should have left lasting traces on it. By a cursory glance the glacialist is led to believe that the markings must be referred to the streams of inland ice, particularly as the island is all along the southern part, at higher as well as at lower elevations, covered with a layer of drift from the "ground" moraine several feet in thickness, while old boulder drift-wolds may be seen in several places. Besides this, foreign travelled blocks are strewn in great numbers along the sides of the island, while striæ appear in many places along the littoral belt and adjacent levels. A closer examination will, however, put these indications in a different light. Thus, with regard to the boulder drift, it will be found that most of the stones and blocks embedded in the same belong to the island itself, and none can with certainty be asserted to have belonged to mountains beyond the island. These drifts must therefore be ascribed to local glaciers, which at one time partly covered the island. With regard to the striæ, which appear in some places at lower levels, I am of the opinion that they were made in what is at present the littoral belt. Foreign travelled blocks, *i.e.* those consisting of various species of granite, are, as stated, only found here at low levels, viz. from the present seashore to an elevation of 38 m. These blocks have, however, I believe, been transported thither by floating glaciers. The elevation, even, in which they are found, indicate that the transport of these foreign blocks can only have begun at a period when the more continuous layers of inland ice were broken up.

The district along the Balsfjord is, on the other hand, to a great extent built of the same kind of crystalline slate rocks which form the Troms Island, and it is therefore impossible to deny with certainty that there are boulders in the drift which have been carried from the land behind. But there is another circumstance which I believe will make this point plainer still. Between the minerals of the district around the Balfsjord there is, as stated above, also a stratum of Saussurite gabbro, which at the bottom of the fjord is of enormous thickness. The Saussurite gabbro is a remarkably tough rock, especially qualified to resist the destructive agencies under a long transport. Should therefore a continuous stream of ice at one time have moved forward along this fjord and its bottom, there seems every reason to assume that fragments of Saussurite gabbro would have been carried with it and now be found along its track, which should particularly be the case with the Troms Island, more advantageously situated for receiving the same than any other spot. But in spite of the most careful search the scientist has not succeeded, either between the loose, solitary blocks or in the Glacial drift here, in discovering a single fragment of Saussurite gabbro. There is, therefore, every reason to assume that the ice-streams which moved down the Balsfjord cannot have reached the Troms Island.

If this conclusion be correct, traces of the Balsfjord ice-stream will not be found along the channels outside, *i.e.* north of Tromsö, viz. neither in the Kval Sound nor in the others in which the ice moved to the sea. There has not been any opportunity of proving this, but from impressions during my frequent journeys along these inlets, I can with confidence assert that no travelled blocks will be found here either whose birthplace was on the upland behind.

A few years ago I examined the greater part of the mouth of the Balsfjord, and I have neither there observed travelled blocks which were transported from the bottom of the fjord. I have therefore come to the conclusion that the continuous ice-stream of the Glacial period cannot have reached beyond the basin of the fjord.

From the premises thus set forth we may draw the deduction that the inland ice in North Norway during the Glacial age did not move forward along the above-described line, viz. through the sounds to the ocean, while we may presume that neither did they travel through the Balsfjord.

By the foregoing line of argument the conditions of Northern Norway must have differed greatly from those which we assume prevailed in Southern Scandinavia under the Glacial period. These two deductions, so much at variance, lead to the following conclusions: (1) That either the Glacial period must have appeared in a far severer form in the southern than in the northern part of the peninsula, or (2) that the conclusions here arrived at are based on an erroneous construction of the evidence presented to us.

With regard to the first of the points, I have already pointed out that every sign seems to indicate that somewhat similar conditions prevailed throughout the Scandinavian peninsula during this period. If thus the inland ice in Northern Norway was not powerful enough to move to the ocean along the sounds, there is but little probability of the conditions having differed in this respect in the southern part. And if, on the contrary, this has been the case in the southern half of the peninsula, there is every reason to suppose that it was so also in Northern Norway, and that ice has moved coastwards, scouring the surface wherever the depth permitted. It seems, therefore, necessary to assume that the second suggestion is correct, and that erroneous conclusions have been arrived at. There seems, for instance, reason to suggest that these deductions, even if logically correct for the district delineated, may not apply to the entire northern half of Norway in general before they have been more extensively corroborated. As to this suggestion, I may reply that the district described above comprises a great area. It includes thus channels of continuous fjords and sounds close upon 120 km. in length, and a coast line 90 km. long, and what is most important, that the channel in question is one which, by the orographical structure, has offered one of the most suited channels for the flow of the ice. If the inland ice has not been powerful enough to move forward by this channel, there is, I believe, little probability of finding a single similar channel in Northern Norway in the district between Salten and the North Cape by which the inland ice has moved to the coast.

If, on the other hand, the southern part of the Scandinavian peninsula is examined, where the inland ice is supposed not only to have filled the fjords but also the entire North Sea and the Baltic, such a circumstance presupposes, in my opinion, conditions so gigantic that they may even from the first be doubted. In fact, the area of the snowfall from which these enormous masses of ice must have been originated is not proportionate to the supposed results. Anything corresponding with such a result is not to be found even within the Arctic zone, which at present suffers most from glaciation. The Polar basin itself is, I believe, nowhere filled with ice masses, which reach the bottom. It is, in my opinion, filled with sea ice in constant drift.

My deduction is, therefore, that the theory of the ice-streams from the Scandinavian peninsula having advanced and covered the North Sea, the Baltic, and reached the Central European plain, England, the Orkneys, and the Shetlands, cannot with the facts at our disposal be accepted as a scientific doctrine.

Travelled Granite Blocks in the Neighbourhood of Tromsö.—Of the loose blocks and boulders which are found in such large numbers about this town, partly embedded in the sand, and partly in old moraine drift, or strewn over the ground, the greatest number had their origin in the solid mountains in the vicinity. These may, as we may have reason to assume, be found at the most different elevations, as the agencies which produced them have been in continuous action down to our time. Real travelled blocks, transported to their present place from a distance, appear also in quantities in this district, but the latter seem to be confined to certain levels. Of these foreign kinds of travelled blocks, most are of granite, and I draw particular attention to these, not only on account of their frequent occurrence, but also from their great dimensions, a great many being thus from a half to one cubic metre, and more. These blocks are mostly rounded, without, however, showing any greater polishing. Striæ are never found on them.

They appear in greatest number up to a height of 25 to 30 m., and more seldom between 30 and 38 m. Up to the former height they are everywhere to be found, while in higher elevations they are difficult of discovery. The line of demarcation upwards is pretty distinctly defined, but the blocks are not always to be found to the above height. There are lines along which the granite blocks are heaped up to this height, and beyond they suddenly disappear. The change is so startling that attention is at once arrested. It should, however, be stated that the line mentioned at 38 m. very nearly answers to the level of the shore line graven in the solid rock, which, greatly pronounced in this place, may be traced for miles.

During the summer of 1882 I carefully examined these conditions, paying the most minute attention to the two sides of Troms Island, 11·3 km. in length, whence I extended my researches along the sounds on both sides of this island, viz. southwards to the tracts about the mouth of the Balsfjord, about 11 km. in length. But while the travelled blocks will be confined upwards to certain levels, no such demarcation will be found downwards. They are to be found down to the lowest level of the littoral belt. Particularly there will within this belt often be found heaps of large blocks ranged in rows along the central tide line, *i.e.* the line marking half tide. On the Ren Island, too, some eighteen miles north of Tromsö, I found once a great number of granite travelled blocks strewn along the lower levels in a line from south to north. With the exception of certain parts of Kvals and Ringvats Islands, the mountains along this district will nowhere be found to consist of granite, neither will there be found strata of granite nature to which these travelled rocks might be ascribed. I must, of course, admit that a series of continuous researches are certainly required before it is possible with certainty to fix the place of birth of these blocks. With the materials at present at our disposal, however, we may arrive at some safe conclusions.

The granite field nearest from the sea inland is found far up in the Divi Valley. Of other granite strata inland there cannot here be a question.

This granite field is 124 km. from the Troms Island. Nearer than the above-described district is, however, the coast with extensive strata of gneiss-granite, which appears particularly prominent over the Kval Island situated just west of the Troms Island. From either of these the travelled blocks must have their origin.

If, now, the Divi Valley is accepted as their place of origin, the transport has been effected from the inland coastwards. If, on the other hand, the Kval Island is designated as their place of production, the transport must have taken place in opposite directions, viz. *from the coast landwards.*

If we now examine the petrographical composition of the travelled blocks, a great many will be found to be formed of varieties which belong to the gneiss-granite of the coast. But there may, on the other hand, be found many blocks among them which seem petrographically to be less related to the gneiss-granite, but to resemble typical inland granite far more.

At first sight, therefore, one would conclude that the travelled blocks might have been brought by both named roads. In this respect I must, however, point out that the gneiss-granite of the coast may petrographically vary considerably, and that it may be interspersed by or run into granite of purer character. In spite even of the greatly varying petrographical forms under which the travelled granite blocks may appear in the neighbourhood of Tromsö, I do not therein see any reason for denying that the travelled blocks may in general have their origin from the gneiss-granite. There are, however, several circumstances which tend to refute the theory of the blocks having been moved thither from the granite fields in the Divi Valley. If the blocks were thus carried down to to the Troms Island and adjacent sounds, it must have been effected in either of the following ways :—

1. Either from the upper part of the Maals River across the mountain ridges down to the bottom of the Balsfjord, and thence outwards to the Troms Island.

2. Or along the bed of the Maals River to the bottom of Malangen, and thence further through the sounds which here run in an easterly direction towards the Troms Island, between the mainland and the southern side of the Kval Island.

And here I must point out that the granite stratum in the Divi Valley appears with its western edge at a height of about 188 m. above the sea. The Divi River runs, however, into the Maals River at an elevation of about 78 m. above the sea, while the bottom of the Balsfjord is separated from the Maals Valley and thus also from the Divi Valley by a higher mountain ridge in which the deepest insections, tending towards the Balsfjord, lie at an elevation of about 160 m., *i.e.* about 78 m. *higher* than the conflux between the Divi and the Maals Rivers. If, therefore, the blocks from the Divi Valley travelled down to the bottom of the Balsfjord, they must have done so over passes which lay 78 m. higher than the conflux between the two rivers! Although it might be most natural to assume that the ice-streams of the Divi Valley followed the bed of the Maals River, the suggestion that an arm from the same might have moved over the higher ridges down to the bottom of the Balsfjord is certainly one which cannot be ignored. But, if this was the case, the granite blocks which had been carried from the Divi Valley in this way ought to be found at the bottom of the Balsfjord at a higher elevation than 30 m. above the sea. Whether travelled granite blocks will be found at the bottom of this fjord is a question which cannot be answered, as but little attention has yet been paid to the same. I am, however, of the opinion, from my own investigations, that they are totally absent in this place.

If granite blocks were, on the other hand, carried down into the Balsfjord by this road, they must, judging by the height to which they are found near Tromsö, have been carried from this place further by drift ice. The beginning of the transport belongs thus to a period when the real Glacial age was closed, and the continuous ice-layer broken up. In this case it might be assumed that the travelled blocks should be found in largest numbers along the sides of the Balsfjord, and decreasing in numbers from the bottom of the fjord outwards to

Tromsö. On this point, too, we are without conclusive proofs, but the examinations have, as already stated, been extended inwards to the mouth of the Balsfjord and its environs, and the results of these disprove such an assumption. Granite blocks are thus to be found about the mouth of the Balsfjord, but in far lesser numbers than over the Troms Island. It is just on the southern part of this island that travelled blocks are found in largest numbers in the whole district; while the circumstance that neither blocks nor fragments of Saussurite gabbro, which, as pointed out, are found in enormous quantities in the neighbourhood of the Balsfjord, can be discovered among the travelled blocks on the Troms Island, further corroborates my belief that no transport of blocks from the Balsfjord outwards to the sea has taken place. In fact, I am fully convinced that the block-transport has taken place *from the coast inwards.*

There is thus every reason to believe that the travelled granite blocks have not been carried out to the Troms Island through the Balsfjord. In fact, there seems more probability that the transport was effected through the Maals River. But, if this was so, travelled granite blocks would have been found on the slopes of the Malang, and here too in decreasing numbers *from the inland towards the outer islands,* which appears, however, not to be the case. I have therefore come to the conclusion that the birthplace of the travelled granite blocks in the vicinity of Tromsö must be referred to the gneiss-granite stratum of the coast, and thus again chiefly to that part of the same which appears at the Kval and Ringvats Islands west of Tromsö. This assumption is supported too by the circumstance that a great number of the travelled blocks, judging by the petrographic composition of the mountains in question, undoubtedly belong to the gneiss-granite of the coast, and that there is nothing to disprove the theory that even the blocks which petrographically seem to differ in composition also belong to the same stratum in composition.

The highest elevation in which the travelled blocks are found in the neighbourhood of Tromsö indicates that the transport of the same has taken place *after* the close of the Glacial period, *i.e.* in an age when the continuous layer of the Ice age had broken up into more or less separated glaciers. Under these circumstances the transport of the blocks from the Kval Island inwards to the Troms Island *must have been effected by floating ice.* The highest line of elevation in which the blocks along the sounds are deposited *indicates, therefore, the height of the sea at the commencement of the block-transport.* And as the blocks are often found in greatest number somewhat below this line, I have come to the conclusion *that block-transport has progressed more rapidly as this period advanced.* I may, however, add that the whole epoch of the block-transport has probably been a short one.

The local conditions of Kval Island seem also to have greatly favoured even the most extensive block-transport at an early age. The continuous layer of ice of the Glacial period has thus, as demonstrated above, been broken up thus early, that the ice remained only in local glaciers of great extent. So early must the block-transport have taken place also in an easterly direction, both through open channels of the Balsfjord and the Kval Sound, and unimpeded by the ice-streams moving down from the mainland. When, however, this, as appears from the blocks in the neighbourhood of Tromsö cannot have been the case, at all events to a limited extent alone, there is herein an obvious proof that special conditions which favoured the current carrying the blocks to the shore did not exist before the epoch which corresponds with the highest level in which the blocks are found.

If the blocks were, as I believe is demonstrated beyond doubt, transported to their places by floating ice, the flow of the currents must have greatly influenced the direction of the block-transport. At a period, therefore, which is determined by the transport commencing eastwards, special conditions must have existed which have caused a stronger flow of the current from the outer coast inwards. There are, in fact, several circumstances which seem to point in this direction. There is in particular that of the Gulf Stream. It is thus evident that the Gulf Stream, which during the Glacial age was diverted from the coast of North Norway, has, in a comparatively recent era, curved towards the coast to a considerable extent.

As is generally known, a complete Arctic Sea fauna existed along the coast of Norway in the early part of the Quaternary age; but by degrees this has been more and more mixed with southern species, an encroachment which continued without interruption to the present time, and is, I believe, still in full operation. Some perfectly pure species of the Arctic fauna may still be met with in some of the deepest fjords of Norway, but even these remains are most probably in retrogression. This constant retrogression of the original Arctic Sea fauna on the coast, and the encroachment of a more southern, must naturally be dependent on currents of warm water coming from the south, and as long as the Arctic fauna alone supervened, these warm currents must have been entirely absent from the coast line referred to in this paper. From the moment access was made for the same, the southern fauna began to manifest itself. In the block-transport here described, which began at a period when the surface of the sea lay, in relation to the fundamental rock, about 30 m. higher than at present, I believe we may find a more exact determination of the time when this curve in the current took place.

There is, besides this circumstance, another of equally great importance which points in the same direction. It is a fact, thus, that fragments of pumice-stone are constantly washed ashore on the coasts of North Norway, and even on those of the Polar lands as far as the Gulf Stream reaches, but pumice-stone is not found at any elevation in Northern Norway, ***but only** at the lowest by the shore.* In fact, the highest line along which pumice-stone is found here *coincides nearly exactly with that of the travelled granite blocks in the neighbourhood of Tromsö.* In no case does it exceed the same.

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A NEW FORM OF SPRING FOR ELECTRIC AND OTHER MEASURING INSTRUMENTS[1]

IN steam- and gas-engine indicators the pressure of the fluid on a piston produces a slight shortening of a spiral spring which is magnified by a lever, and so the pressure of the steam or gas is recorded. In what are usually known as spring balances there is also occasionally a magnification of the elongation of a spiral spring effected by the use of a rack and pinion. Such magnifying arrangements, however, not only introduce inaccuracy by the bad fitting of hinges or of teeth, an inaccuracy which is aggravated by wear, but they increase the cost of measuring-instruments and their liability to get out of order.

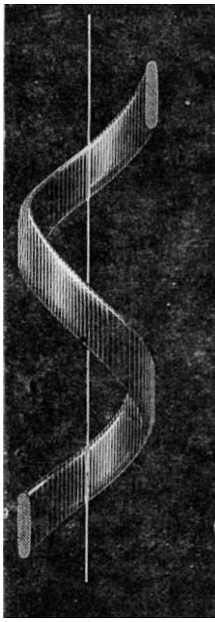

FIG. 1.

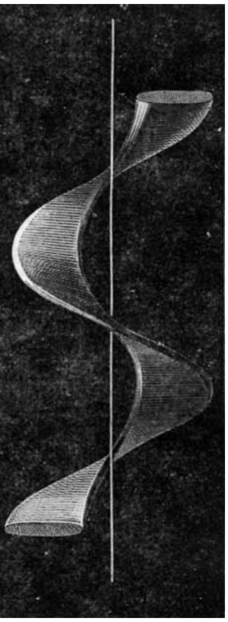

FIG. 2.

And, as an example of the difficulty of using the wheel and pinion for the magnification of an angular motion produced by a small force, the authors mentioned the fact that although they used this plan for a year or more in their electric measuring-

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[1] Abstract of a paper read before the Royal Society by Profs. W. E. Ayrton, F.R.S., and John Perry, M.E.